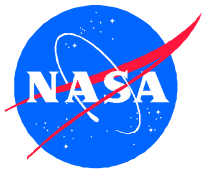

ULDB PDR

Systems Engineering & Balloncraft

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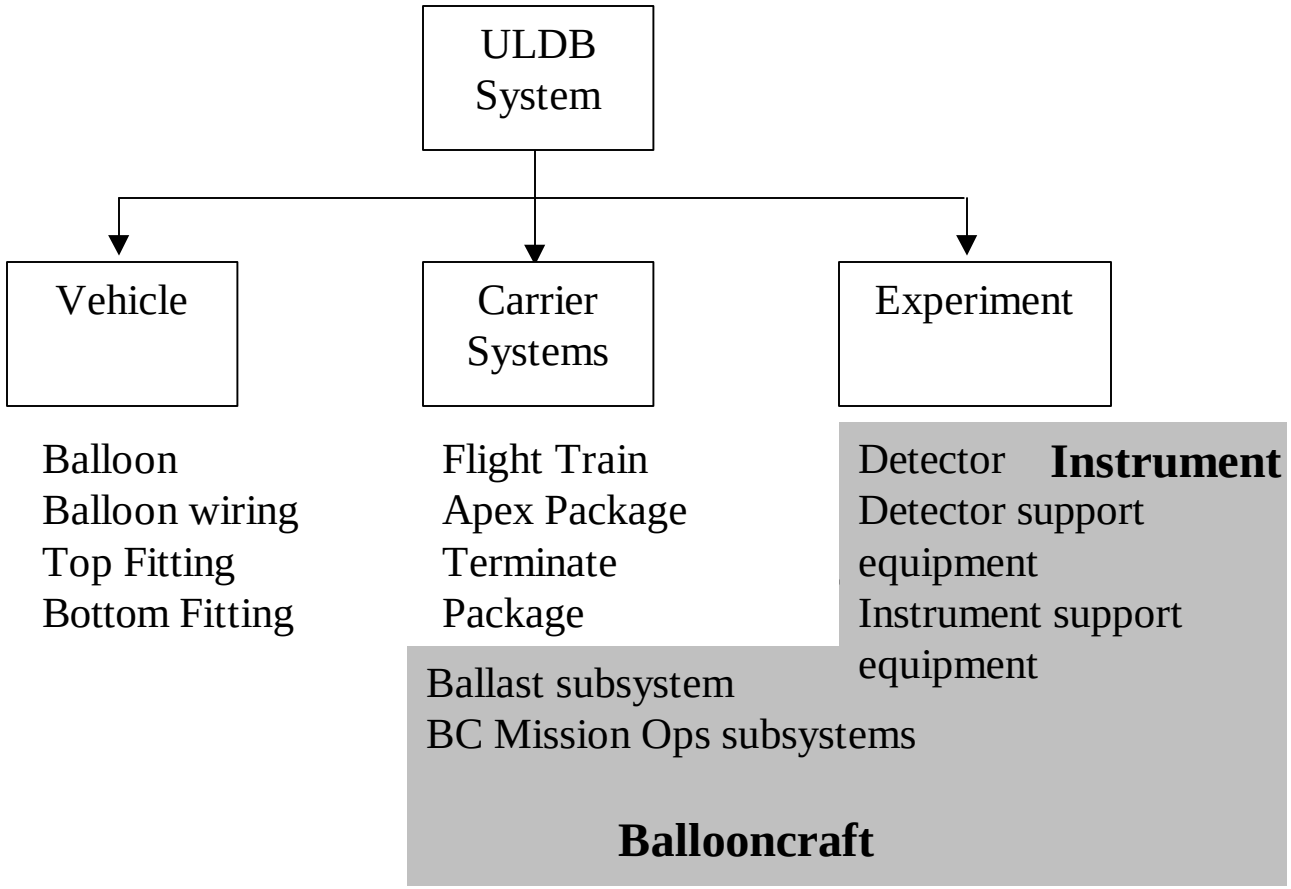
November 4-5, 1998

ULDB Systems Engineering

- Definition of Terms
  - Science Detector: The scientist-provided device(s) that observe, detect or measure.
  - Science Instrument: The scientist-provided equipment which includes the science detector and the detector support equipment (flight processor(s), high voltage supplies, etc.).
  - Science Experiment: The scientist-provided instrument and the balloncraft support systems which are provided to meet instrument requirements (instrument power, instrument data handling, balloncraft structure, etc.)
  - Carrier Systems: All NASA/GSFC/WFF Code 820 provided flight systems with the exception of the Vehicle and experiment specific support systems. Includes the flight train, the CAP, the ballast, and the electronic subsystems required for mission operations.
  - Balloncraft: All components and subsystems below the launch pin. Commonly known as the gondola.
  - Launch pin: The attachment point to the launch crane or launch vehicle.
  - Flight Train: The recovery system and mechanical subsystems between the launch pin and the balloon.

ULDB Systems Engineering



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ULDB Systems Engineering

- Systems Engineering Process
  - Mission and Requirements Analysis
    - Requirements compiled from multiple sources
      - NASA HQ & GSFC Management
      - Demo 2000 science teams
      - Polidan Study
      - Mission and Operations Users
    - Documented in Design-to Requirements Document
    - Presented and reviewed at Mission Definition Review (MDR), 11/4/97

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ULDB Systems Engineering

- Systems Engineering Process (cont.)
  - Requirements Allocation
    - Initial PBS allocation made at MDR
    - Subsystem functional areas identified
    - Full PBS flow-down allocation complete at PDR
      - See Requirements Allocation Matrix
    - Requirements Traceability of subsystems
  - Trade Studies
    - WFF Code 500 trade study team established September 1997
    - Identification of Alternative Design Concepts
      - Brainstorming Sessions, Market Surveys, Satellite Technology
      - Feasibility and Risk assessments
    - Optimum Design Concept presented and reviewed at Systems Definition Review (SDR) 3/25/98

ULDB Systems Engineering

- More Definition of Terms
  - Configurations Items (CIs) are produced end-items
    - HWCI and SWCI
  - Product Breakdown Structure (PBS)
    - PBS item numbers are same as CI numbers, they're the same thing!
  - DTRD requirement numbers
    - Do Not Equate to the PBS item numbers
      - A single DTRD requirement can result in multiple Configuration Items
      - A single Configuration Item can satisfy multiple DTRD requirements

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ULDB Systems Engineering

- Systems Engineering Process (cont.)
  - Preliminary Design Phase
    - Trade study team continued as design team
    - Requirements analyzed and refined
    - Design dependent requirements and interfaces established
    - Design analyses and engineering development tests performed
    - Verification Plans established
      - Master Verification Plan documented at PDR
      - Preliminary Verification Matrix documented at PDR
    - Design solution which meets all requirements established
    - Operations Concepts refined

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- Systems Engineering Process (cont.)
  - Critical Design Phase
    - Define and control interfaces
      - Configuration Control Documents (CCDs) for all subsystems finalized
      - Interface Control Document (ICD) for instrument to Balloncraft interface finalized
    - Detailed design completed (build-to specifications)
    - Verification Plans refined
    - Subsystem Critical Design Reviews (CDRs) to begin in December 1998
    - System CDR in March 1999

ULDB Systems Engineering

- Systems Engineering Process (cont.)
  - Fabrication and Integration Phase
    - Fabricate, procure and assemble
    - Verification of Hardware Configuration Items (HWCIs)
    - Physically integrate system
    - Perform integrated system verification
      - Initial system verification culminates in engineering test flight of Balloncraft and full-scale balloon in Australia - winter 1999-2000 (without instrument)
      - Mission Readiness Review (MRR) prior to test flight deployment
      - Integration and system verification with instrument begins March 2000
      - MRR prior to Demo 2000 deployment

ULDB Systems Engineering

- Systems Engineering Process (cont.)
  - Operations Phase
    - Conduct the Demo 2000 mission
    - Baseline mission outcomes
    - Breathe sigh of relief

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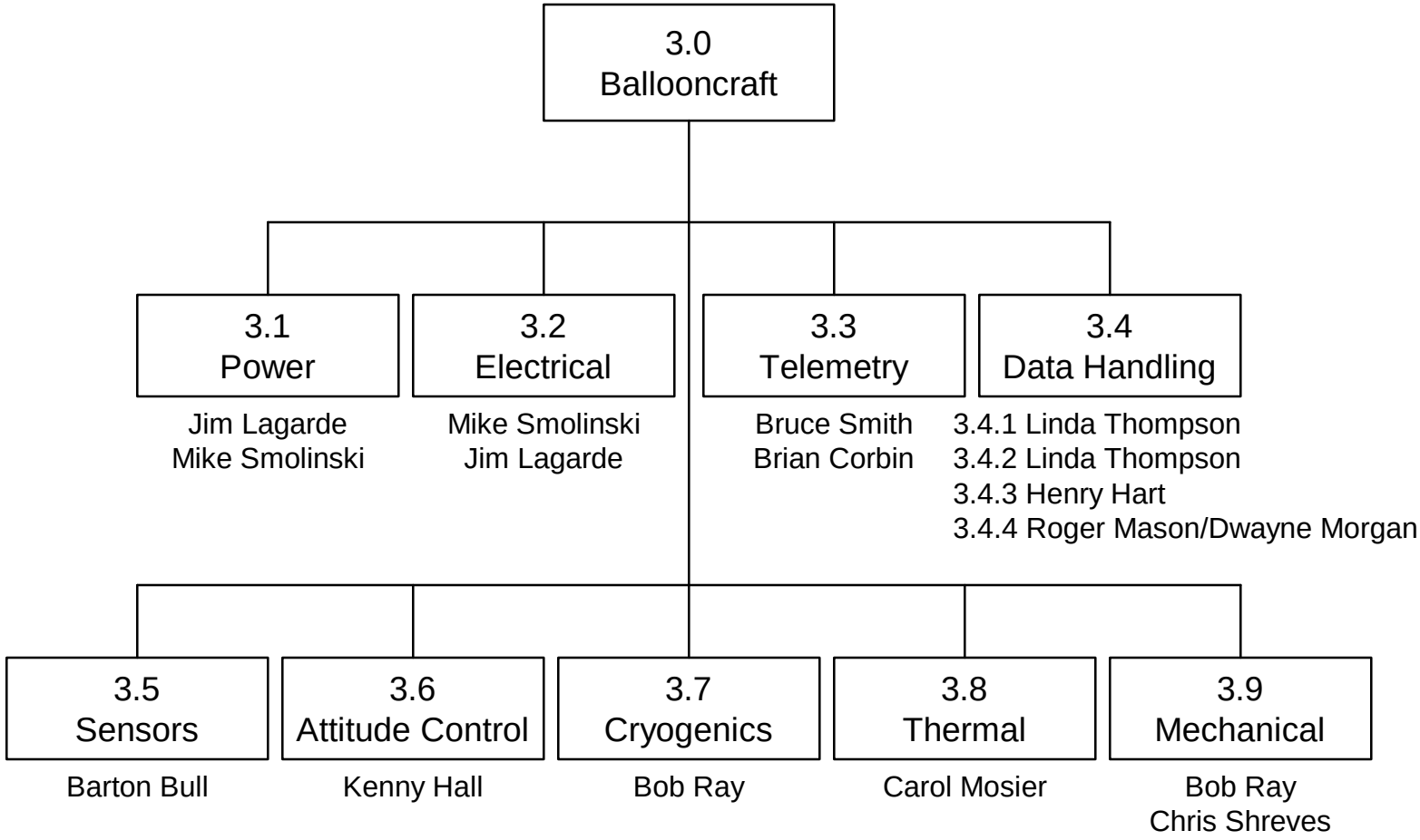
ULDB Balloooncraft Development Team



ULDB Balloooncraft

- Balloooncraft Schematic
- Mechanical Layouts
- Product Breakdown Structure
  - Hardware Configuration Items (HWCIs)
  - Software Configuration Items (SWCIs)
- Preliminary Command and Data Channel lists
- HWCI spreadsheet
  - Power consumption
  - Mass
  - Volume
  - Cost

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ULDB Balloncraft

- System Mass, Volume, Cost, Power
  - Volumes per Mechanical Drawings
  - Balloncraft power consumption average 151.5 watts without heaters and without instrument

MASS BUDGET	Lbs	Kg
Balloon	6155.95	2798.16
Flight Train with UTP, CAP	726.50	330.23
Balloncraft	2481.25	1127.84
Contingency	292.25	132.84

Balloncraft Mass	Lbs	Kg
Gondola Structure	385.00	175.00
Power Subsystem	492.00	223.64
Other Instrument and Mission Support Equipment	404.25	183.75
Instrument	1200.00	545.45
Total	2481.25	1127.84

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